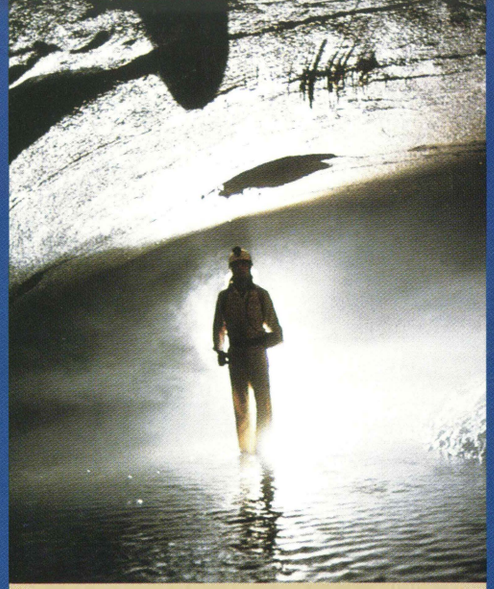
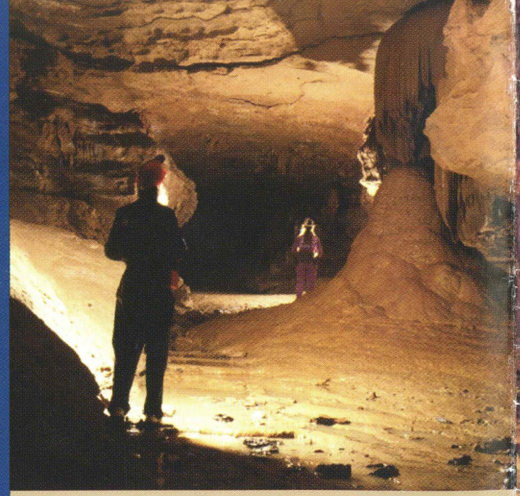


Cave conservation

Cavers and cave biologists alike abide by the caver's motto: "Take nothing but pictures, leave nothing but footprints, kill nothing but time." Given the isolated nature of caves, fragility of speleothems and vulnerability of cave life, caution must be taken not to damage our cave resources. The entrances to many caves on public land are gated, which prohibits trespassers but allows bats and other cave life to travel in and out of caves.

Numerous laws protect caves and cave resources, including the Missouri Cave Resources Act, the Federal Cave Resources Protection Act and the Federal Endangered Species Act. These laws prosecute cave trespassers, vandals and those who allow pollutants into caves and other karst features. Cave visitors must not dig for artifacts, and they should refrain from littering, marking, breaking or removing anything natural, or smoking in caves (tobacco smoke contains chemicals harmful to cave animals and discolors speleothems). Scientific permits are required from the Missouri Department of Conservation to collect any cave life or speleothems.

Above photo by Rickard Walk

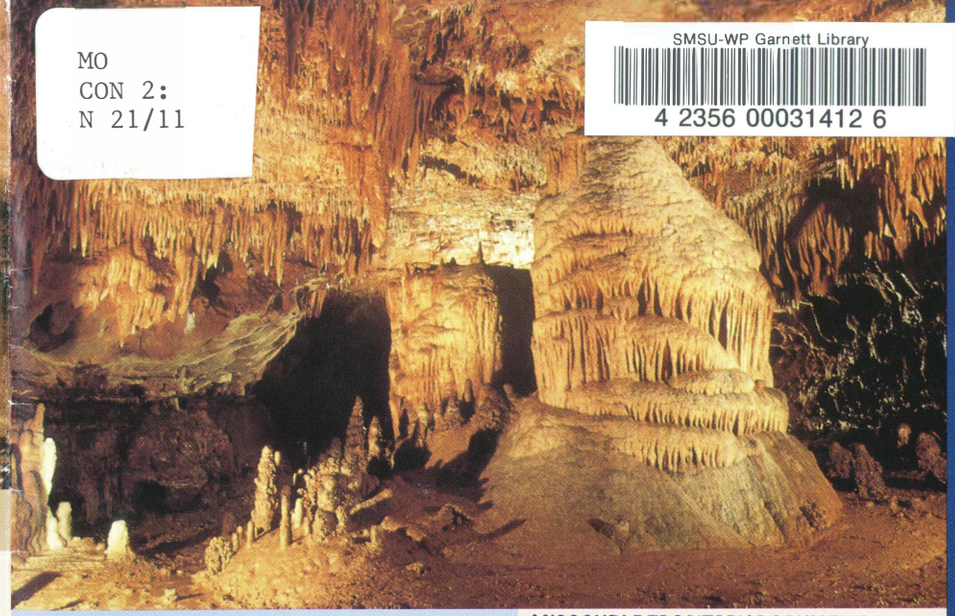


Cave recreation

Missouri offers a wealth of caving opportunities. Before you venture into a cave, however, make sure you know basic safety rules. The most common caving hazard is hypothermia, caused by exposure to 55 degree Fahrenheit water. Heavy storms can quickly flood caves, posing serious drowning threats. Cavers should wear sturdy clothing and footwear, as well as a helmet with a chinstrap and a headlamp. Three reliable light sources are essential. Never go caving alone; a group of four cavers is best. Also, cavers should tell someone where they will be caving, provide a map to the cave and phone number of the cave owner. Many caving groups, called grottos, organize caving trips in Missouri and provide training for safe spelunking.

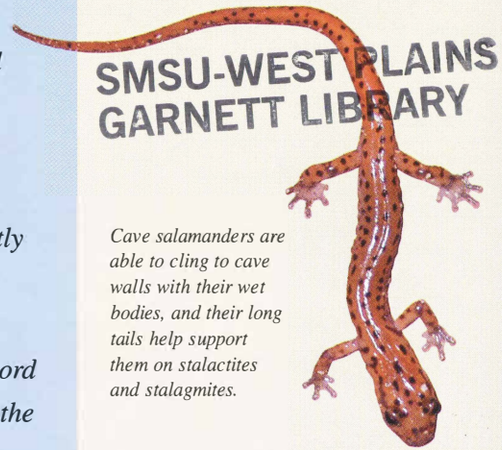
Poster photo of entrance to an Ozark pool room by Rickard Walk. Cover photo of scene at Little Hamilton Cave by Rickard Walk. Above photo by Rickard Walk. Cover photo of cave salmander by William R. Elliott.
Cover cave map of Missouri cave density by William R. Elliott.

Text: Text adapted by Carol Davit from articles by William R. Elliott, David Ashley, Tom Aley and Mark McGimsey.
Design: Patrick Kipp

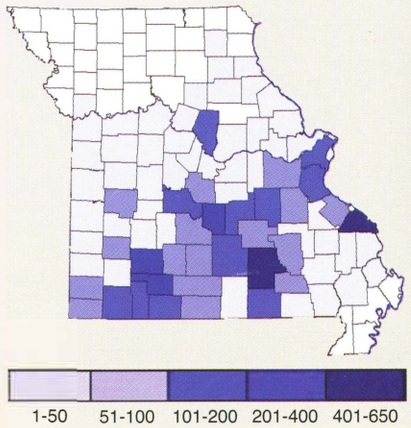


Caves, springs, sinkholes and natural bridges are all natural features of karst regions. Much of Missouri is a karst landscape of porous limestone and dolomite with deep fissures. Slightly acidic groundwater flows through these cracks and slowly dissolves rock to form karst features. The word karst comes from the German for the limestone region of Krš, Slovenia.

Missouri is known as the Cave State because of its large number of caves located in karst areas. At least 5,700 caves are recorded, with about 100 new caves discovered each year. There are caves in 78 of our 114 counties. Most are in the Ozarks, but some are as far north as Hannibal. Perry County has about 650 caves, the most of any county in Missouri.



Cave salamanders are able to cling to cave walls with their wet bodies, and their long tails help support them on stalactites and stalagmites.



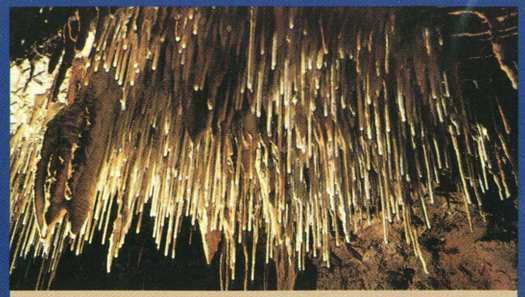
The above map shows the number of caves per county in Missouri.

Missouri's Natural Communities: Karst

History of our Karst

Caves have formed throughout millions of years. Calcium-rich limestone and dolomite (similar to limestone, but also containing magnesium) rocks were formed 450 to 350 million years ago. These rocks are composed of the shells and other remains of marine organisms that lived in the ocean that once covered most of North America. By 66 million years ago, parts of Missouri had dolomite and limestone up to 1,500 feet thick. Through this rock, groundwater carved the caves and other karst features we see today. As water continually flows through caves and seeps through cave walls, the eventual fate of a cave is to erode completely away. Most natural bridges are the remains of former caves.

Top image: *fossilized crinoids*
Above: *fossilized mammoth tooth*
Fossil photos by Rickard Walk.



Speleothems

As ground water seeps through caves, minerals from the water are deposited on cave ceilings, walls and floors. These mineral deposits are called speleothems, and come in many shapes, sizes and colors. Stalactites, which resemble icicles, are deposits of calcite (calcium carbonate) that grow downward from the ceiling of a cave. Stalagmites are deposits of calcite that build upward from a cave floor as a result of water dripping from above. Other speleothems are flowstone, which can cover cave walls, spiny-looking aragonite bush and cave popcorn. Caves in the Ozarks often contain spathites (soda straws constructed of small aragonite cones) and cave canopies, false floors and stalactiflats. The latter three types grew as flowstone over clay and gravel banks, which eroded away and left hanging structures, some of which are attached to stalactites. Some speleothems can take hundreds or thousands of years to grow.

Top image: *soda straws*
Above: *A drop of water drips from a stalactite into a pool below. Stalactites are mineral remnants of dripping water. Photos by Rickard Walk.*

Karst Region Life

Cave animals are adapted to low light levels or total darkness. Many do not need to protect their skin from the sun, and so have no pigment, like the grotto salamander and cave crayfish. Cave animals living in total darkness have no need for sight, and so do not develop eyes, like the Ozark cavefish. These animals are called troglobites, or true cave dwellers, and they could not survive in any other habitat. Aquatic troglobites often are called stygobites. Other troglobites include nonpigmented species of cave millipedes, small crustaceans called isopods (related to pill bugs or rolly pollies) and amphipods, and flatworms called planaria.

Troglophiles ("cave lovers") are animals that live in caves but are not restricted to them. Orange and brown cave and dark-sided salamanders live in caves and surrounding forests; some crickets live in caves but would be equally at home in your basement. Certain spiders and beetles are troglophiles.

Cave visitors, or trogloxenes, spend considerable time in caves but also need other habitats to complete their life cycle. Many of Missouri's 15 species of bats roost or hibernate in caves, but also depend on forests or other natural communities. While in caves, bats deposit droppings, or guano, which is the source of nutrients for many true cave dwellers. Bears, pickerel frogs and certain insects also hibernate in caves.

At cave entrances, shade-tolerant, moisture-loving plants such as walking fern and mosses grow. Eastern phoebes and turkey vultures frequently build nests on small ledges around cave openings. Leaf litter, sticks and tiny invertebrates often blow or wash into cave entrances, providing more nutrients for cave animals.

In order to survive through the winter, bats need to maintain a slow metabolism to conserve fat reserves. The protected cave environment provides ideal conditions for bats and other animals. Some caves have a chilly entrance area, providing good hibernation for certain bats. Other caves have high domes, which collect warm air in the summer, good for maternity colonies of gray bats. Photo by William R. Elliott.

The grotto salamander, being a true troglobite, grows skin over its eyes and has no skin pigment. Photo by William R. Elliott.

The Karst Landscape

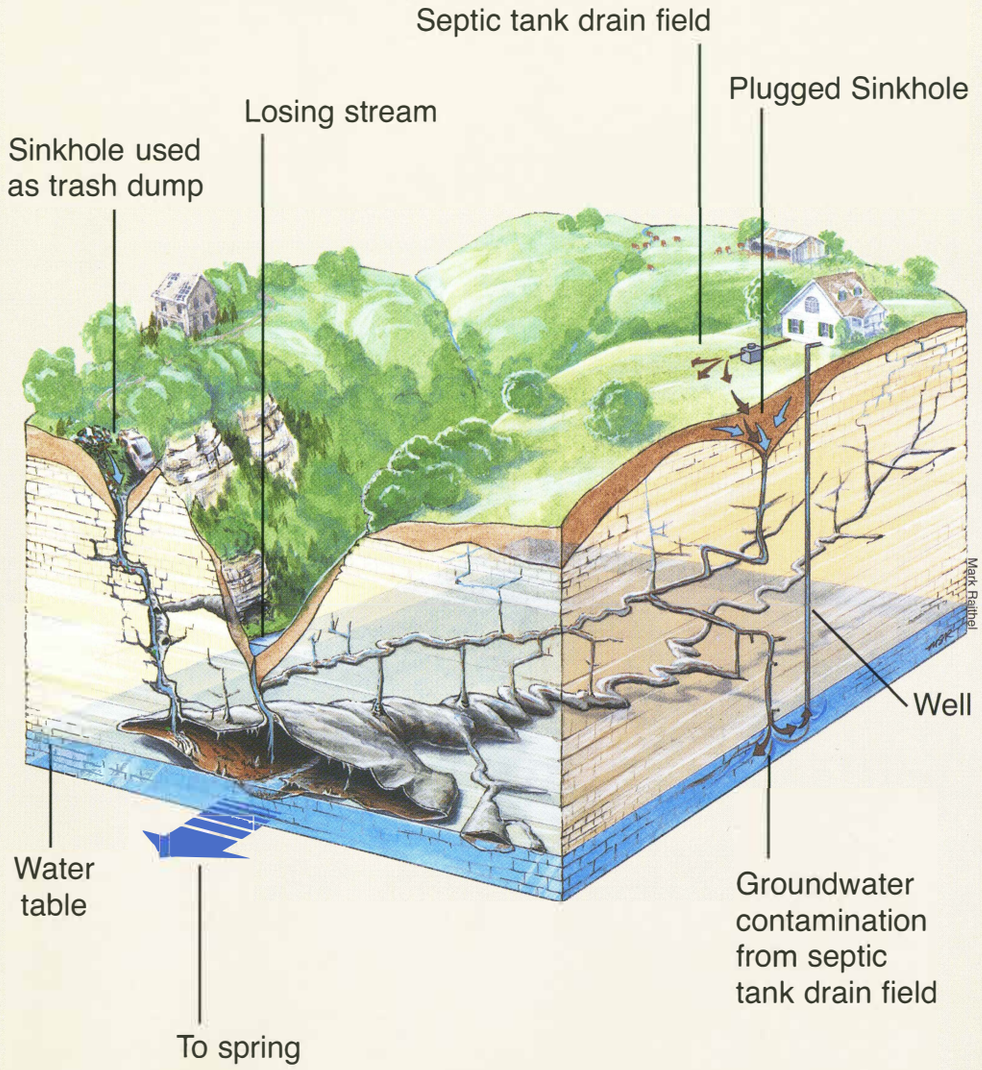
In a karst landscape, water moves quickly through dissolved-out channels in limestone and dolomite. The water flows down sinkholes or losing streams to the water table, or empties into caves or springs. Karst groundwater can travel at about one mile a day, often moving through large openings that do not filter out microbes, organic debris or even large pieces of trash. In other natural landscapes, water travels only a few feet per year, and it seeps slowly through tiny spaces in soil or sand, which filters out most pollutants or potentially harmful bacteria.

All the land through which water moves to groundwater or into springs or caves is called a recharge area. Due to features such as underground channels, sinkholes and losing streams, a recharge area in a karst landscape can be many miles wide. The longest distance that groundwater is known to travel in the United States is 39.5 miles, from a segment of the Eleven Point River to Big Spring.

Given the vulnerability of water quality in karst landscapes, extra precautions must be taken to keep recharge areas free of potential water pollutants. Minimizing development in karst regions decreases the amount of storm water runoff, often laden with pollutants, that enters recharge areas. Retaining vegetation between farm fields and streams helps filter agricultural chemicals and animal waste from water before it enters losing streams. Proper placement of septic tanks prevents human waste from entering sinkholes.

Below photo by Rickard Walk.

How Karst Systems Work



Principle Karst Features In Missouri

Caves are openings in the earth formed by rock dissolving or collapsing. Caves may not extend more than a few feet underground or may have many miles of passageway. Streams may flow into or out of caves (swallets or resurgences), or cave floors may be covered with gravel, dirt or bat guano. Cave entrances may be wide openings or may be vertical shafts or fissures (pit caves). The physical nature of each cave determines what life forms will live there.

Springs are openings where underground streams or seeps continually or intermittently release water into caves or on the ground. Spring water often flows into rivers or other streams. At the spring source, water is about 58 degrees Fahrenheit year-round. Fish like the central stoneroller and rainbow darter, and salamanders such as the Ozark hellbender and dark-sided salamander and pickerel frog are characteristic of springs. Species of amphipods, isopods and snails also can be abundant at springs.

Sinkholes are depressions in the surface of the landscape. They are formed when the roof of a cave below ground collapses or when limestone or dolomite rock underlying the soil is slowly dissolved by water. Eventually, sinkholes can become entrances to caves, but many convey water to a cave stream with or without an opening.

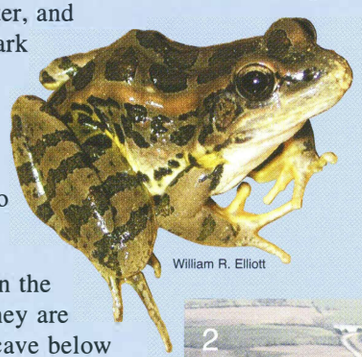
Fens are open, wet areas within forests or woodlands, where groundwater flowing through limestone or dolomite seeps to the soil surface. Fens have nearly constant oozing water and small, flowing springs. Plants in fens are adapted to wet, alkaline, calcium-rich soil, and many grow in no other natural community.

1: *Fire Hydrant Spring, Shannon County, Missouri. Photo by Jim Rathert.*

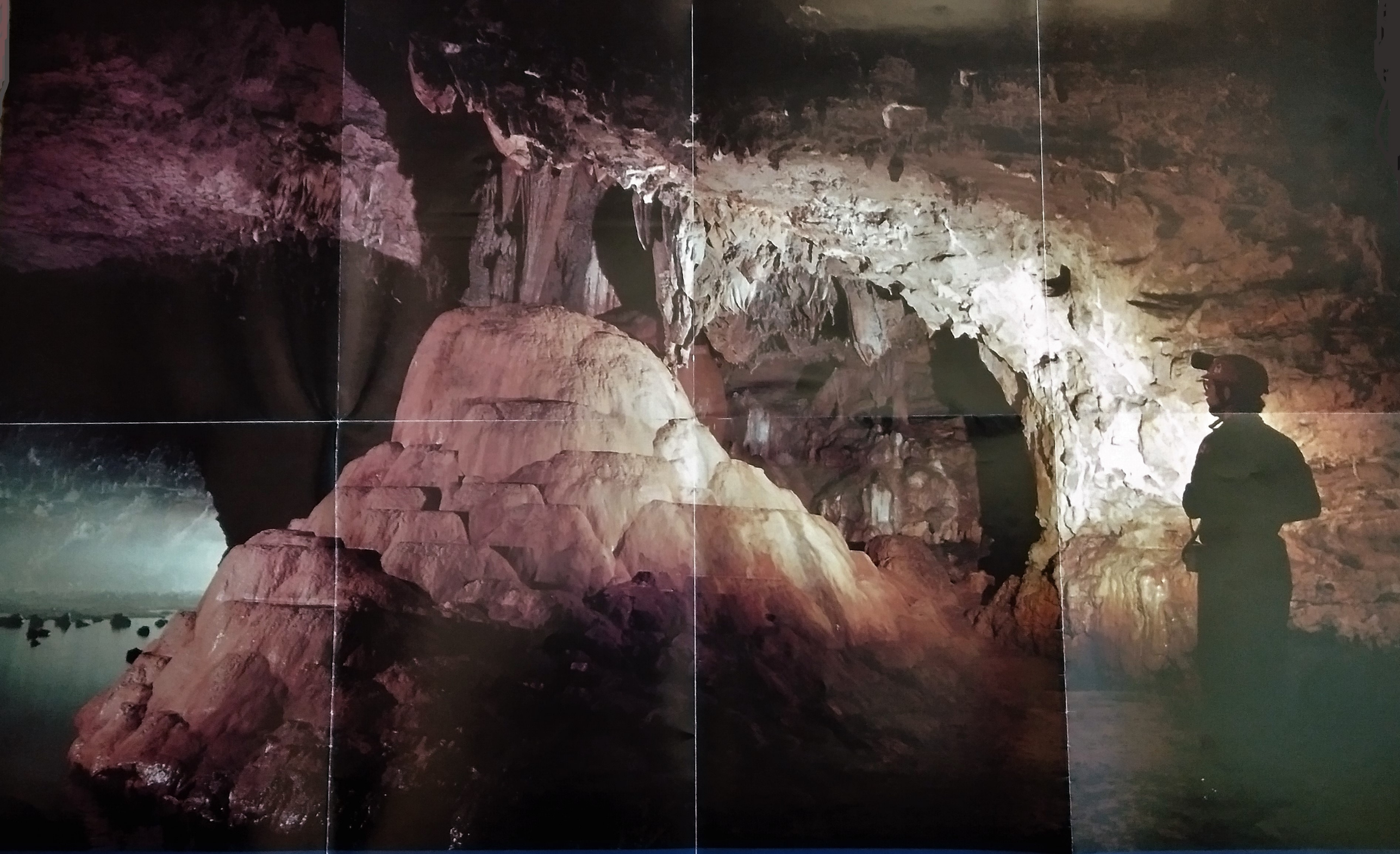
2: *Karst networks can sometimes be identified from the air by water-filled sinkholes. Photo by Rickard Walk.*

3: *Walking fern commonly grows near cave entrances and around springs. Photo by William R. Elliott.*

Pickerel Frog



William R. Elliott



Missouri's Natural Communities: Karst